

# **A COMPARISON OF OPERATIVE TIMES IN ARTHROSCOPIC ACL RECONSTRUCTION BETWEEN ORTHOPAEDIC FACULTY AND RESIDENTS: THE FINANCIAL IMPACT OF ORTHOPAEDIC SURGICAL TRAINING IN THE OPERATING ROOM**

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## **ABSTRACT**

There is no published data regarding the financial impact of training orthopaedic residents in the operating room. No comparisons between orthopaedic faculty and residents in regard to operative time and costs are known.

One hundred eleven cases of anterior cruciate ligament reconstruction with or without partial meniscectomy were evaluated from 1996 to 1997. Fifty-three cases met the selection criteria of times, documentation and identification of the surgeon. Twenty-one cases were performed by the orthopaedic attending (RCS) while 32 cases were performed by the senior orthopaedic resident. All procedures had the same faculty member present in the operating room either as the primary surgeon or as an assistant providing supervision and instruction as needed.

In a two year period, comparisons were made between the attending and residents for the total anesthesia time and actual operative case time. Attending case time and anesthesia times averaged 94.62 minutes (range 60-125 min) and 128.1 minutes (range 84-185 min) respectively. Resident case and anesthesia times averaged 137.09 minutes (range 95-210 min) and 190.48 minutes (range 145-255 min) respectively. The anesthesia time was significantly less for the attending ( $p < .0001$ ) as was the case time ( $p < .0001$ ).

The true costs of training orthopaedic surgery residents in the operating room is not known. The operative time and subsequent cost difference between experienced faculty and orthopaedic residents in certain arthroscopic procedures is not inconsequential. On average, the difference is equivalent to \$228.73 per case for anesthesia costs. Based on increased operative times, operating room costs, on average, were increased by \$661.85. The significant differences demonstrated between residents and faculty suggest the need to develop strategies and technical training facilities in order to improve orthopaedic residents' surgical skills and efficiency outside of the cost-central operating room.

## **INTRODUCTION**

The clinical training that physicians receive after graduating from medical school is an important component of the health care system in this country, and is undergoing careful financial scrutiny. Unfortunately, there is very little objective data of the true cost of graduate medical education. Medicare payments for resident education increased to approximately \$7 billion in 1997.<sup>10</sup> In the case of orthopaedic surgical training, there is virtually no objective data to indicate the

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TABLE 1

Attending (RCS)	ACL +/-	Anesth (min)	Case (min)
AS	-	140	110
EA	-	145	90
LC	-	160	115
GC	-	185	110
MH	-	105	90
DS	-	125	104
OM	-	97	71
DB	-	90	80
RS	+	160	125
MD	+	170	115
OB	+	147	90
JS	+	135	100
IM	+	90	60
CT	+	123	94
TL	+	140	105
CC	+	100	93
DB	+	155	125
MC	+	120	85
JS	+	120	90
ED	+	84	60
average		128.09	94.61

+ denotes ACL reconstruction with partial meniscectomy.

- denotes ACL reconstruction without partial meniscectomy.

direct economic impact to hospitals or the government. This is important, as Medicare policies impact orthopaedic training programs through government financing and reimbursement policies.

Unfortunately, the future of graduate medical education is in transition secondary to these inherent financial costs. Currently the United States Government provides a significant portion of the monetary support for graduate medical training.<sup>5</sup> Medicare antifraud and abuse programs have also had an impact on orthopaedic surgical training due to *qui tam* decisions with huge monetary settlements against medical schools across the country. Medicare regulations require that attending surgeons be present for the entire or "key portions" of the procedure and personally examine and evaluate new patients.<sup>10</sup> Although these regulations are still vague they are being supported with impressive antifraud resources. Antifraud units received more than \$100 million in 1999 and are slated for \$200 million in 2002.<sup>12</sup> Attending faculty surgeons aware of the Physicians at Teaching Hospitals (PATH) antifraud initiative may be overly cautious and believe they must perform essentially all care on their patients, thus affecting resident training.<sup>8</sup>

Orthopaedic residents begin their training typically by observing attending surgeons and more senior residents perform procedures in the time constrained operating room with the patient under regional or general anesthesia. Subtle procedural knowledge (i.e., how to perform a specific task) may not be readily understood or noticed. The training of technical aspects of orthopaedic surgery have traditionally been taught in the operating room. Since operating time must be kept to a minimum, there is little opportunity for reflection or practice during a procedure.

The purpose of this study is to compare operative and anesthesia times in arthroscopic anterior cruciate ligament (ACL) reconstruction, with or without meniscectomy, between an experienced orthopaedic faculty member and senior orthopaedic residents, in order to evaluate the costs of surgical training of orthopaedic residents.

## METHODS

During a two-year period (1996-1997), one hundred eleven cases of arthroscopic ACL reconstruction with or without partial meniscectomy, were performed. Both hamstring grafts and patellar tendon grafts were utilized. All of the procedures had the same faculty member (RCS) either as the primary surgeon or as an assistant providing supervision and instruction as needed. A review of the patient medical charts including the anesthesia record and the operative notes was performed. Anesthesia time was defined as beginning when the patient was intubated to the time the patient was extubated after reversal of the anesthetic. Cases in which the operation was performed under spinal anesthesia were excluded from analysis due to the variability and difficulty in defining an accurate anesthesia time. Operative time was defined as beginning with the initial skin incision and ending when the postoperative dressing had been applied. Both operative and anesthesia times were documented by the circulating nurse for that particular case. The attending cases were for the most part his private patients or patients who had requested his services as the primary surgeon. These cases were performed entirely by him, although residents did participate as assistants in a small number of these procedures (see Table 1). The cases selected as resident cases were performed by a senior orthopaedic resident with the same attending (RCS) as an assistant, providing supervision, instruction and assistance as needed (see Table 2).

A number of cases were not selected for inclusion in the comparative analysis. Cases in which there was insufficient documentation in regard to anesthesia and/or operative times were excluded. Other cases were excluded if the extent of involvement of the faculty sur-

TABLE 2

Residents	ACL +/-	Anesth (min)	Case (min)
ML	-	165	115
JS	-	195	135
FH	-	190	140
BB	-	250	143
MD	-	180	125
JO	-	190	125
KS	-	245	175
RM	-	200	155
DM	-	175	122
CC	-	170	120
PR	-	175	110
CP	-	210	160
AB	-	225	140
RC	-	150	115
JH	-	160	135
EG	-	185	125
JD	+	255	200
JK	+	170	120
LP	+	200	125
WW	+	175	155
AL	+	145	95
RS	+	165	120
JB	+	165	115
MG	+	155	120
MD	+	170	125
AG	+	200	140
JM	+	245	182
GV	+	200	150
DR	+	160	110
FS	+	190	130
RC	+	240	210
CC	+	195	150
average		188.57	139.14

+ denotes ACL reconstruction with partial meniscectomy.

- denotes ACL reconstruction without partial meniscectomy.

geon or resident was not clear. No revision ACL reconstructions were included, nor were cases in which another procedure other than a partial meniscectomy was performed in concert with the ACL reconstruction such as concomitant collateral ligament reconstruction or meniscal repair. After careful review, 53 total cases met the selection criteria. Twenty-one cases were performed by the faculty surgeon. Thirteen of these 21 cases also had a partial meniscectomy performed. Thirty-two cases were performed by the senior orthopaedic resident. Sixteen of these 32 cases also received a partial meniscectomy. All information was tabulated by chart review

and data was organized and analyzed on an Excel program (Microsoft; Redmond, WA) utilizing a standard PC platform.

## RESULTS

Comparisons were made between the attending faculty and the residents for the anesthesia time and the operative case time. The differences were found to be highly significant ( $p < .0001$ ). Attending case times averaged 94.62 minutes with a range of 60 to 125 minutes, while anesthesia times for these cases averaged 128.10 minutes with a range of 84-185 minutes. Resident case times averaged 137.09 minutes with a range of 95 to 210 minutes, while anesthesia times for these cases averaged 190.48 minutes with a range of 145 to 255 minutes. The results were analyzed utilizing the t-test with equal variances. (See Table 3). Thus, the anesthesia time was significantly less for the attending (one-tailed  $t$  value = -7.40,  $df=51$ ,  $p < .0001$ ) as was the case time (one-tailed  $t$  value = -6.42,  $df=51$ ,  $p < .0001$ ). On average, the difference in anesthesia times for resident cases was equivalent to \$228.73 per case based on \$55.00 billed per each additional 15 minutes. Based on the increased case time, an additional \$10.61 per minute (Acuity Level II) for the use of the operating room was billed resulting in an average of \$661.85 per resident case. No complications were noted from the added operative time. No significant differences in operative times between type of reconstruction (hamstring or patellar tendon) were noted.

## DISCUSSION

The acquisition of surgical proficiency in orthopaedic surgery is vital to the training of residents. However, due to many outside influences, the opportunity to "learn by doing" while in the operating room may not be as easily afforded to the resident as it was in the past. A graduated increase in responsibility and independence has educational value but also carries a price in terms of increased operative time and costs. We have demonstrated a significant difference in the operative and anesthesia times between one orthopaedic attending and senior-level residents in the performance of arthroscopic ACL reconstruction. This procedure was chosen because it is a relatively common operation and requires a certain degree of technical proficiency to perform well.

The need for developing motor skills in surgery has been previously recognized. Lippert et al., described a psychomotor skills course for orthopaedic residents in which operative techniques were taught outside of the operating room without hazard to the patient or regard to time constraints.<sup>9</sup> In describing the development of

TABLE 3

Variables (in minutes)	Attending Surgeon (RCS)	Residents
<b>Anesthesia time</b>		
Mean	128.10 minutes	190.48 minutes
Range	84-185	145-255
Standard Deviation	29.05	30.57
<b>Case</b>		
Mean	94.62 minutes	137.09 minutes
Range	60-125	95-210
Standard Deviation	18.86	26.14

motor skills in orthopaedic education, Kopta reported that the present approach in the acquisition of motor proficiency is “usually random, frequently incomplete and often conducive to unselected learning.” The results are an extremely inefficient skill teaching program in a specialty which is highly oriented to motor tasks.<sup>7</sup> Other authors have identified the need for residents to begin developing efficient procedural knowledge and introduced structured perceptual motor surgical practice emphasizing different models.<sup>2</sup> Ericsson et al., emphasized the role of deliberate practice in the acquisition of expert performance.<sup>4</sup> Others have encouraged operative teachers to follow simple learning principles, provide feedback on multiple procedural skills and to use structured assessments to help developing surgical residents.<sup>11</sup>

The differences noted in operative and anesthetic times not only confine the patient to longer periods in the operating room, but also impart a financial impact in terms of direct costs incurred. At our institution, each additional 15 minutes of anesthesia is billed at \$55. Comparing the differences of the averages of anesthesia times between the attending and resident this would account for an additional \$228.73, on average, for the resident's cases. Added operating room time as well increases costs, and when billed for level II acuity, this added an average \$661.85 to the cost of surgical training. Assuming that on average resident operative and anesthesia times are longer than attending, and taking into account that at our institution orthopaedic residents perform approximately 1700 cases during their training, the added direct costs of operative training is significant. Bridges et al., noted similar differences be-

tween general surgical residents and faculty. They demonstrated a significant net time cost to training residents in the operating room. This was equivalent to nearly \$48,000 per graduating resident assuming 4 years of operative training.<sup>1</sup>

### CONCLUSION

One would expect experienced orthopaedic faculty members to be able to perform a specific procedure in a more timely manner than a resident. However, the direct economic costs of training orthopaedic residents on patients may suggest a need to identify strategies to make the process more efficient and cost effective. Crucial components of clinical training can be detached from patient care and practiced elsewhere.<sup>6</sup> There appears to be a need for technical training facilities in which orthopaedic residents can augment their surgical experience for patients developing their skills outside of the operating room. Alternatives such as animal or cadaver labs and even “virtual surgery” labs have been examined, but the expense needed to create and maintain other technical resource facilities is large.<sup>3</sup> We have shown that the extended times and added costs in one particular procedure performed by residents may have a significant financial impact and can justify such an investment in resident education.

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